Condensed Matter Physics

FABRICATION OF PIEZOELECTRIC/MAGNETOSTRICTIVE COMPOSITES

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Multilayer Composites of magnetostrictive and piezoelectric oxides show a giant magnetoelastic effect.[1] Theory predicts similar effects in composites of the organic piezoelectric Polyvinylidene fluoride (PVDF) and the rare-earth ferromagnet $Tb_{1-x}Dy_xFe_2$ (terfenol-D).[2] A large piezoelectric coupling in PVDF and high magnetostriction (λ) for Terfenol-D are the required characteristics for strong ME coupling.

We have chosen three different ferromagnetic compounds for our investigation: i) Fe_3O_4 powder (bulk $\lambda = 40 \times 10^{-6}$), ii) Ni powder (bulk $\lambda = -33 \times 10^{-6}$), iii) Terfenol-D powder (bulk $\lambda = 1600 \times 10^{-6}$). We have prepared $(PVDF)_{1-x}/(Fe_3O_4)_x$, $(PVDF)_{1-x}/(Ni)_x$, and $(PVDF)_{1-x}/(Terfenol\text{-}D)_x$ composites (x = 0.1 to 0.5 by weight). After mixing the desired proportions of powders of constituents, the samples were prepared using two processing methods. In one method, the mixture was pressed at ~1000 psi to form 1-2 mm thick disks. In the other method, the mixture was dissolved in acetone, cast it to make sheets and pressed when the sheets were dry. All the samples are poled perpendicular to the sample plane by applying a field of 1000 V. The results of the measurements of piezoelectric coefficient and magnetoelectric coefficient will be presented.

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[1]G. Srinivasan et al, Phys. Rev. B (in press Nov. 1, 2001)
[2]C. W. Nan et al, Phys. Rev. B 63, 144415 (2001)